

Claims

1. Chewing gum comprising at least one polymer, chewing gum ingredients and enzymes, wherein at least one of said polymers forms a substrate for at least one of said enzymes.

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2. Chewing gum according to claim 1,
wherein said chewing gum includes center filling.

10 3. Chewing gum according to claim 1 or 2,
wherein said chewing gum includes coating.

4. Chewing gum according to any of the claims 1-3,
wherein said chewing gum ingredients comprise sweeteners and flavors.

15 5. Chewing gum according to any of the claims 1-4,
wherein said chewing gum ingredients comprise softeners and further additives.

6. Chewing gum according to any of the claims 1-5,
wherein said at least one polymer constitutes a chewing gum base.

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7. Chewing gum according to any of the claims 1-6,
wherein said at least one polymer comprises at least one copolymer.

8. Chewing gum according to any of the claims 1-7,
25 wherein said at least one copolymer is polymerized of at least two different monomers, each comprising 1-99%.

9. Chewing gum according to any of the claims 1-8,
wherein said at least one polymer comprises at least one biodegradable polymer.

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10. Chewing gum according to any of the claims 1-9,

wherein at least one of said at least one biodegradable polymer comprises at least one biodegradable elastomer.

11. Chewing gum according to any of the claims 1-10,
5 wherein at least one of said at least one biodegradable polymer comprises at least one biodegradable elastomer plasticizer.

12. Chewing gum according to any of the claims 1-11,
10 wherein at least one of said at least one biodegradable polymer comprises at least one polyester polymer obtained by polymerization of at least one cyclic ester.

13. Chewing gum according to any of the claims 1-12,
15 wherein at least one of said at least one biodegradable polymer comprises at least one polyester polymer obtained by polymerization of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

14. Chewing gum according to any of the claims 1-13,
20 wherein at least one of said at least one biodegradable polymer comprises at least one polyester obtained by polymerization of at least one compound selected from the group of cyclic esters, alcohols or derivatives thereof and carboxylic acids or derivatives thereof.

15. Chewing gum according to any of the claims 1-14,
25 wherein said at least one polyester obtained by polymerization of at least one cyclic ester is at least partly derived from α -hydroxy acids such as lactic and glycolic acids.

16. Chewing gum according to any of the claims 1-15,
30 wherein said at least one polyester obtained by polymerization of at least one cyclic ester is at least partly derived from α -hydroxy acids and where the obtained polyester comprises at least 20 mole% α -hydroxy acids units, preferably at least 50 mole% α -hydroxy acids units and most preferably at least 80 mole% α -hydroxy acids units.

17. Chewing gum according to any of the claims 1-16,
wherein the at least one or more cyclic esters are selected from the groups of
glycolides, lactides, lactones, cyclic carbonates or mixtures thereof.

5 18. Chewing gum according to any of the claims 1-17,
wherein lactone monomers are chosen from the group of ϵ -caprolactone, δ -
 δ -valerolactone, γ -butyrolactone, and β -propiolactone. It also includes ϵ -caprolactones,
 δ -valerolactones, γ -butyrolactones, or β -propiolactones that have been substituted
10 with one or more alkyl or aryl substituents at any non-carbonyl carbon atoms along
the ring, including compounds in which two substituents are contained on the same
carbon atom.

19. Chewing gum according to any of the claims 1-18,
wherein the carbonate monomer is selected from the group of trimethylene
15 carbonate, 5-alkyl-1,3-dioxan-2-one, 5,5-dialkyl-1,3-dioxan-2-one, or 5-alkyl-5-
alkyloxycarbonyl-1,3-dioxan-2-one, ethylene carbonate, 3-ethyl-3-hydroxymethyl,
propylene carbonate, trimethylolpropane monocarbonate, 4, 6dimethyl-1, 3-
propylene carbonate, 2, 2-dimethyl trimethylene carbonate, and 1, 3-dioxepan-2-one
and mixtures thereof.

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20. Chewing gum according to any of the claims 1-19,
wherein cyclic ester polymers and their copolymers resulting from the
polymerization of cyclic ester monomers are comprising poly (L-lactide) ; poly (D-
lactide) ; poly (D, L-lactide) ; poly (mesolactide) ; poly (glycolide) ; poly
25 (trimethylenecarbonate) ; poly (epsilon-caprolactone) ; poly (L-lactide-co-D, L-
lactide) ; poly (L-lactide-co-meso-lactide) ; poly (L-lactide-co-glycolide) ; poly (L-
lactide-co-trimethylenecarbonate) ; poly (L-lactide-co-epsilon-caprolactone) ; poly
(D, L-lactide-co-meso-lactide) ; poly (D, L-lactide-co-glycolide) ; poly (D, L-lactide-
co-trimethylenecarbonate) ; poly (D, L-lactide-co-epsilon-caprolactone) ; poly
30 (meso-lactide-co-glycolide) ; poly (meso-lactide-co-trimethylenecarbonate) ; poly
(meso-lactide-co-epsilon-caprolactone) ; poly (glycolide-cotrimethylenecarbonate) ;

poly (glycolide-co-epsilon-caprolactone).

21. Chewing gum according to any of the claims 1-20,
wherein said at least one polymer has a degree of crystallinity in the range of 0 to
5 95% and more preferably 0 to 70%.
22. Chewing gum according to any of the claims 1-21,
wherein at least one of said at least one polymer has amorphous regions.
- 10 23. Chewing gum according to any of the claims 1-22,
wherein said at least one polymer is aliphatic.
24. Chewing gum according to any of the claims 1-23,
wherein the molecular weight of said at least one polymer is within the range of 500
15 – 500000 g/mol, preferably within the range of 1500 - 200000 g/mol Mn.
25. Chewing gum according to any of the claims 1-24,
wherein at least one of said enzymes catalyzes the degradation of said at least one
polymer.
- 20 26. Chewing gum according to any of the claims 1-25,
wherein said chewing gum after use is partly disintegrated due to the influence of
said enzymes.
- 25 27. Chewing gum according to any of the claims 1-26,
wherein at least one of said enzymes influences the polymer substrate with a partial
disintegration of the chewing gum as a result.
28. Chewing gum according to any of the claims 1-27,
30 wherein at least one of said enzymes influences the polymer substrate with a partial
disintegration and a crumbling structure of the chewing gum as a result.

29. Chewing gum according to any of the claims 1-28,
wherein at least one of said enzymes after use of the chewing gum is catalyzing the polymer substrate degradation until said at least one polymer is completely degraded.

5 30. Chewing gum according to any of the claims 1-29,
wherein at least one of said enzymes is active in atmospheric air and pressure and are accelerating the degradation of said at least one polymer.

10 31. Chewing gum according to any of the claims 1-30,
wherein at least one of said enzymes is contained in the chewing gum, gum base, center filling or coating.

15 32. Chewing gum according to any of the claims 1-31,
wherein at least one of said enzymes is accelerating the degradation of said polyester obtained by ring-opening polymerization of at least one cyclic ester.

20 33. Chewing gum according to any of the claims 1-32,
wherein at least one of said enzymes is accelerating the degradation of said polyester obtained by polymerization of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

25 34. Chewing gum according to any of the claims 1-33,
wherein said chewing gum comprises at least one polyester obtained by ring-opening polymerization of at least one cyclic ester and at least one polyester obtained by polymerization of at least one alcohol or derivative thereof and at least one acid or derivative thereof.

30 35. Chewing gum according to any of the claims 1-34,
wherein the chewing gum has water content of less than 10 wt%, preferably less than 5 wt%, more preferably less than 1 wt% and most preferably less than 0.1 wt%.

36. Chewing gum according to any of the claims 1-35,

wherein the chewing gum is capable of absorbing water in an amount of at least 0.1 wt%, preferably at least 5 wt%, more preferably at least 10 wt%, even more preferably at least 20wt% and most preferably at least 40 wt%.

- 5 37. Chewing gum according to any of the claims 1-36,
wherein the chewing gum comprises filler in an amount of 0 to 80 wt%.
- 10 38. Chewing gum according to any of the claims 1-37,
wherein the concentration of said enzymes is in the range of 0.0001 wt% to 50 wt%
of the chewing gum.
- 15 39. Chewing gum according to any of the claims 1-38,
wherein the concentration of said enzymes is in the range of 0.001 wt% to 10 wt% of
the chewing gum.
- 20 40. Chewing gum according to any of the claims 1-39,
wherein the concentration of said enzymes is in the range of 0.01 wt% to 5 wt% of
the chewing gum.
- 25 41. Chewing gum according to any of the claims 1-40,
wherein the amount of said enzymes is in the range of 0.0001 to 80 wt% related to
the amount of gum base in the chewing gum.
42. Chewing gum according to any of the claims 1-41,
25 wherein the amount of said enzymes is in the range of 0.001 to 40 wt% related to the
amount of gum base in the chewing gum.
43. Chewing gum according to any of the claims 1-42,
30 wherein the amount of said enzymes is in the range of 0.1 to 20 wt% related to the
amount of gum base in the chewing gum.
44. Chewing gum according to any of the claims 1-43,

wherein at least one of said enzymes is selected from the group consisting of oxidoreductases, transferases, hydrolases, lyases, isomerases and ligases.

45. Chewing gum according to any of the claims 1-44,
5 wherein at least one of said enzymes is an oxidoreductase.

46. Chewing gum according to any of the claims 1-45,
wherein at least one of said enzymes is a hydrolase.

10 47. Chewing gum according to any of the claims 1-46,
wherein at least one of said enzymes is a lyase.

48. Chewing gum according to any of the claims 1-47,
wherein at least one of said hydrolase enzymes is acting on ester bonds.

15 49. Chewing gum according to any of the claims 1-48,
wherein at least one of said hydrolase enzymes is a glycosylase.

50. Chewing gum according to any of the claims 1-49,
20 wherein at least one of said hydrolase enzymes is acting on ether bonds.

51. Chewing gum according to any of the claims 1-50,
wherein at least one of said hydrolase enzymes is acting on carbon-nitrogen bonds.

25 52. Chewing gum according to any of the claims 1-51,
wherein at least one of said hydrolase enzymes is acting on peptide bonds.

53. Chewing gum according to any of the claims 1-52,
wherein at least one of said hydrolase enzymes is acting on acid anhydrides.

30 54. Chewing gum according to any of the claims 1-53,
wherein at least one of said hydrolase enzymes is acting on carbon-carbon bonds.

55. Chewing gum according to any of the claims 1-54,
wherein at least one of said hydrolase enzymes is acting on halide bonds,
phosphorus-nitrogen bonds, sulfur-nitrogen bonds, carbon-phosphorus bonds, sulfur-
5 sulfur bonds or carbon-sulfur bonds.

56. Chewing gum according to any of the claims 1-55,
wherein at least one of said enzymes is selected from the group of lipases, esterases,
depolymerases, peptidases and proteases.

10 57. Chewing gum according to any of the claims 1-56,
wherein at least one of said enzymes is an endo-enzyme.

58. Chewing gum according to any of the claims 1-57,
15 wherein at least one of said enzymes is an exo-enzyme.

59. Chewing gum according to any of the claims 1-58,
wherein at least one of said enzymes has a molecular weight of 2 to 1000 kDa,
preferably 10 to 500 kDa.

20 60. Chewing gum according to any of the claims 1-59,
wherein at least two of said enzymes are combined.

61. Chewing gum according to any of the claims 1-60,
25 wherein at least one of said enzymes requires a co-factor to carry out its catalyzing
function.

62. Chewing gum according to any of the claims 1-61,
wherein at least one of said enzymes is incorporated in the chewing gum.

30 63. Chewing gum according to any of the claims 1-62,
wherein at least one of said enzymes is incorporated in the gum base.

64. Chewing gum according to any of the claims 1-63,
wherein at least one of said enzymes is incorporated in the coating.

5 65. Chewing gum according to any of the claims 1-64,
wherein at least one of said enzymes has optimum activity in the pH range from 1.0
to 11.0, preferably 4.0 to 8.0 and most preferably 4.0 to 6.0.

10 66. Chewing gum according to any of the claims 1-65,
wherein at least one of said enzymes has optimum activity at temperatures in the
range of -10 to 60°C, preferably 0 to 50°C, more preferably 5 to 40°C and most
preferably 10 to 35°C.

15 67. Chewing gum according to any of the claims 1-66,
wherein at least one of said enzymes has optimum activity in relative humidity
conditions in the range of 10 to 100% RH, preferably 30 to 100% RH.

20 68. Chewing gum according to any of the claims 1-67,
wherein said chewing gum is prepared by a one-step process.

69. Chewing gum according to any of the claims 1-68,
wherein said chewing gum is prepared by a two-step process.

25 70. Chewing gum according to any of the claims 1-69,
wherein said chewing gum is prepared by a continuous mixing process.

71. Chewing gum according to any of the claims 1-70,
wherein said chewing gum is compressed and prepared by use of compression
techniques.

30 72. Use of at least one enzyme for degradation of biodegradable chewing gum

73. Use of at least one enzyme according to claim 72,
wherein said at least one enzyme comprises hydrolases.
74. Method for degradation of biodegradable chewing gum,
5 whereby at least one biodegradable polymer is at least partly degraded by means of
at least one enzyme.
75. Method according to claim 74,
wherein said enzyme is mixed together with said at least one biodegradable polymer
10 by chewing.